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No. 600

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EAST GERMANY

GOALS, USE OF GENETIC ENGINEERING DISCUSSED

East Berlin SPEKTRUM in German Vol 9 No 6, Jun 78 pp 9-12

[Article by Sinaida Rosenthal, member, GDR Academy of Sciences, Central Institute for Molecular Biology: "Postulates, Experiments and Applications of Genetic Engineering"]

[Text] New discoveries in biology raise numerous ethical questions that are of far-reaching significance in their application to the future of mankind. The discussions are concentrated especially on the problem of genetic manipulation with emphasis on ethical standards for the applicability of scientific results to humans. Inseparable is the question concerning the responsibility of the scientist which he can perceive only in the unity of humanism and science.

As medicine and biology advance it becomes possible for man to render decisions concerning his personal, biological fate. The revolution in biology has made accessible to scientific analysis and synthesis the elementary rudiments of biological processes. This confronts society with problems that are comparable in significance to the effects of findings in atomic physics. It is therefore the duty of the biologist to provide information on these results and their future effects, and to formulate corresponding stipulations for the social sciences and for the conduct of social processes.

Developments to date in the natural sciences were also based on humans in the sense that their results were wither beneficial or harmful. The results of molecular-biological research, however, involve man directly. This transcends the competence od individual specialists and requires a sociological and socio-structural foundation, viz. a responsible attitude on the part of all humans.

The "Discovery" of Living Systems

By "genetic engineering" is meant a laboratory technology which ties into one complex the methods of biochemistry, genetics, microbiology, and virology. It permits:

1. synthesis of DNA segments with defined information content in vitro by enzymatic or chemical means or isolation of corresponding DNA segments;

2. interconnection in vitro of DNA segments of the most varied origin (viral, plasmid, microbial, plant, animal, and human), which in nature normally do not recombine with one another;

3. incorporation of these recombined DNA molecules in cells by means of DNA vectors, separating individual DNA molecules (cloning); and

4. multiplication (amplification) of these cloned molecules in the host cell.

An organism is thus created with a desired genotype and, if possible, also with a phenotype (albumin pattern) which cannot be produced with the usual genetic methods.

While molecular biology through the beginning of the seventies still described these processes primarily on the molecular plane of heredity and gene expression*, a new situation has now arisen since this technology elevates the bioscientist to "a creator" of new life systems although still on a very limited scale. Biology thus follows in the footsteps of chemistry and other scientific disciplines by entering into a period of "discovery" not of new materials but of new life systems. Although some of this may be reminiscent of "biological alchemy" the first steps to control biological processes which concern man himself have been taken. This new technology did not fall from the sky, but has in part a long prior history, for example, genetic transformation whose principle was published in 1944.

There exist different barriers in nature to the free exchange of genetic material. At the same time there exist, in the form of viruses and plasmids, genetic units that circumvent such barriers or that may penetrate with a certain probability. These units are matched to their hosts and channel free genetic exchange. By use of such viruses and plasmids as vectors for the transfer of foreign and far removed genetic material, the natural barriers are overcome.

The exchange of foreign genetic information can occur in three basic directions:

1. at the procaryotic level, i.e., between bacteria.

2. between procaryotes and eucaryotes, i.e., between bacteria and cells of animal or plant origin.

3. at the eucaryotic level, i.e., between animal or plant cells or vice versa.

Of special interest is the middle group and here again the gene transfer of eucaryotic information in bacteria.

*Conversion of genetic information into proteins

What value and utility do the results and questions of this new technology of genetic engineering have?

The various utilitarian possibilities of the new technology are formulated in very general terms in publications, with very few exceptions. Sometimes long-term goals are represented as though they were attainable tomorrow and not just in twenty years.

Society, government organizations, colleagues in research and practice of medicine and veterinary medicine, in agriculture, microbiology, food industry, pharmaceutical industry, and in environmental protection require from the basic researchers concrete and realistic estimates of what is real in five to seven years. A purposeful and rapid transfer of the new findings and methods to corresponding practical areas requires a new quality in interdisciplinary collaboration on a national and international plane. The new technology of molecular biology plays a central role in gaining recognition of basic biological processes, especially of structure, function and regulation of genes, with high priority to that of the eucaryotic gene. Treatment of these themes is closely connected to a multiplicity of methodological advances. These advances are based on fundamental methods of hybridization of complementary nucleic acid segments and of biochemical or chemical synthesis of highly imprinted complementary nucleic acid segments. These are used for subsequent development of isolation processes for nucleic acids in their sequential analysis.

This technique has been used to substantially expand our knowledge concerning animal viruses in the past few years. The results of gene analysis of animal DNA viruses and their gene expression demonstrate that the animal viruses are excellent models for the study of nuclear structure and of gene expression of eucaryotic cells. Once before during the infancy of molecular biology this was demonstrated for the role of bacteria viruses in hereditary processes. These findings will moreover yield in the foreseeable future the first conclusions concerning the relationship among these viruses and thus assist in recognizing epidemiological connections.

Research concerning DNA tumor viruses has a special significance in the technique of "genetic engineering." On the one hand, in gene transfer experiments in animal cells correspondingly mutated virus vectors are required that decrease the hazards to which the experimentor and the environment are exposed. On the other hand, the analysis of gene sections of such viruses, which transform the host cell into malignant cells, will especially be accelerated by means of these techniques.

As far as utility is concerned, the next few years will see further developments in diagnostic procedures based on known methods of hybridization, of restriction analysis (where the virus nucleic acid is split into defined sections by characteristic enzymes), and by demonstrating viral proteins. These diagnostic procedures are expensive requiring funds and training of scientific and technical personnel. In the long range, however, they are necessary for all countries within the framework of a strategy to combat tumor diseases of viral origin.

Manipulated Microorganisms

A realistic goal of practical use could be posed by using manipulated microorganisms for the production of albumins that are difficult to obtain by other means. One such solution has been developed for a bacterial enzyme. Its use, however, has been limited for the time being to date gene segments containing specific genetic information of medical or pharmaceutical interest are accessible only to a limited extent. Although the genes for the red blood pigment of the rabbit and of humans as well as for immunoglobulin, egg albumin, and insulin of rats have been reproduced in bacteria, it has not been possible to achieve synthesis of these proteins in the bacterial host. On the other hand, a short nucleotide sequence synthesized chemically which was coded for a small peptide hormone called somatostatin, was injected into the lac region of a modified plasmid. This region permits conversion of the foreign information into an RNA and this in turn into a protein. This protein was even split correctly by chemical means after isolation from the bacterium resulting in the creation of the active peptide. As a consequence, the construction of vectors that permit an RNA synthesis of the foreign DNA and then a protein synthesis, becomes an essential methodological goal that is currently being pursued intensively in many laboratories and hopefully may be solved relatively rapidly. In this connection the question must be raised as to whether at the base of this molecular biological technology it is possible to develop long-range economic means for the production of proteins of interest to medicine, pharmaceuticals, industry, and science.

A long-range utility can be expected from more in-depth knowledge of several key problems of human biological and medical significance. The new technology enables insight into the molecular origin of diabetes and other hormonal disturbances. Diabetes does not have a uniform medical etiology. The concept of diabetes includes a complex of different disease forms that are very probably caused by differing molecular disturbances. It involves defects or irregularities in the formation of insulin, its transport, or its binding in the receptor tissue. These complex reactions in the final analysis make up the diabetic etiology. Despite extensive worldwide efforts we are not yet able to explain why insulin production is usually curtailed suddenly in diabetes of children and juveniles, and slowly in diabetes of adults and the aging. The technology of recombinant DNA makes possible analysis of the reasons why cells of the islands of Langhans of certain diabetics are unable to produce sufficient insulin. Since only a small amount of pancreatic tissue can be taken from a live individual, the new detection methods must be optimized in such a manner that the test (perhaps for quantification of the insulin messenger-RNA) may be carried out with sufficient sensitivity and conclusiveness. From this, realistic estimates may be made as to how many practical problems must be solved in order to derive "only" one practical diagnostic procedure for medicine.

The scientists are discussing by what means and to what extent this technology might help us gain insights into the molecular mechanisms of gene defects in humans. For most gene defects only careful first steps may be undertaken in this direction at all; in individual cases our experience might perhaps be intensified. The complexity of the gene of human cells requires, when non-selective detection procedures are available, an analysis of several thousand bacteria clones in order to find a specific DNA segment. This is not possible in practice. As a result such a task assumes the availability of messenger-RNA, as much as possible of human material. This raises the question as to how realistic it is in a human to transmit a specific gene in case of a gene defect and in this manner to undertake a causal therapy (genetic substitution). Two basic variants arise: gene transfer in germ cells and in somatic cells. I consider a genetic transformation of somatic cells from the standpoint of practical untility as very hypothetical at this time, but as possible in individual selected cases. I consider gene transfer in human germ cells as not feasible for scientific and ethical reasons. In laboratories, however, extensive model investigations must be performed. Such experiments are necessary in order to gain insight into the regulatory principles of cell multiplication and its control and into the conversion of genetic information into defined albumins. Only in this manner, by introducing biological probes, will we reach a better understanding of what takes place in eucaryotic cells by releasing and suppressing the synthesis of specific albumins and in a broader sense what differentiation and aging at the cellular level imply.

In gene transfer in somatic cells, the effect of the foreign gene is limited to the lifespan of the cell. If such a genetic function is to have effect, the organism itself must be used for further multiplication of the genetically changed cells. This is possible only when parent cells of specific somatic tissues are genetically reprogrammed, to multiply themeselves and thus also the foreign gene. This gene must be transformed into protein and if not already done in the parent cell then in the offspring cells which are subjected to a differentiation and maturing.

Another way is also possible. Gene transfer experiments can be combined with classical embryological methods. For example, cells of genetic origin from early embryonic states, united into one embryo, can be transplanted into a pseudo-pregnant mother animal and grow into a live animal. Corresponding experiments were conducted with mice. In such a "mosaic animal" the development of the foreign information, its effects on the individual organism under the influence of normal cells and its descendants can be studied. As long as such experiments on animals are conducted with necessary care, no criticism can be voiced.

It is suspected that some genetic information directly (by its action in the host) or indirectly (by the location of its integration into the gene) reduces growth of the host or causes it to die so that they are not capable of multiplying. It is conceivable that other recombinant molecules make its host potentially dangerous to humans or their environment. This danger arises from the fact that a known or still unknown factor reconstitutes its still harmless host bacterium into a potential disease stimulant.

Development of a disease and the disease itself are expressed in a complex interplay between a factor (e.g. chemical compound, molecule, stimulant) from the environment and the organism, and have not been explained in all facets of their complex being. More or less known danger factors are: toxins, resistance to antibiotics, virulent genes, oncogenes, virogenes. In addition a potential danger can arise from chemical compounds that hinder cellular repair mechanisms or that sensitize mutagens. For this reason scientists in many countries of the world agreed not to conduct certain experiments and to demand special physical and biological safeguards for those researchers that engage in similar investigations.

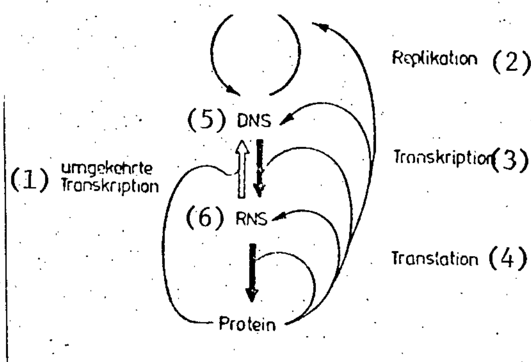
Scientists of the GDR, in agreement with the ethical standards of our socialist society, feel responsible to prevent misuse of scientific findings and to be concerned about not endangering humans and the environment by their experiments. This was expressed in a stand taken by the Biosciences Assembly of the GDR Academy of Sciences on problems of technologies that permit a new kind of genetic manipulation. A national committee will shortly issue guidelines for performing experiments in genetic engineering, that are based on international experience.

These guidelines are valid for all scientists who work in scientific institutes or industrial installations of the GDR and who apply genetic engineering techniques.

However, we cannot close out eyes to the fact that there exist entirely different dangers in connection with progress in the sciences. Misuse of scientific findings cannot be excluded as long as there are forces that profit from it. Experience from the recent past relative to the misuse of scientific findings--such as dropping of the atomic bomb, destruction of forest and field cultures by "defoliants," construction and intended introduction of new mass destruction weapons such as the neutron bomb--clearly demonstrates that the same knowledge can be used for quite different and even diametrically opposed aims,

It is therefore our intent to decisively counter such misuse by supporting all scientific and social forces that join us in exclusively humanistic application.

Key: 1. reverse transcription
2. replication
3. transcription
4. translation
5. DNA
6. RNA



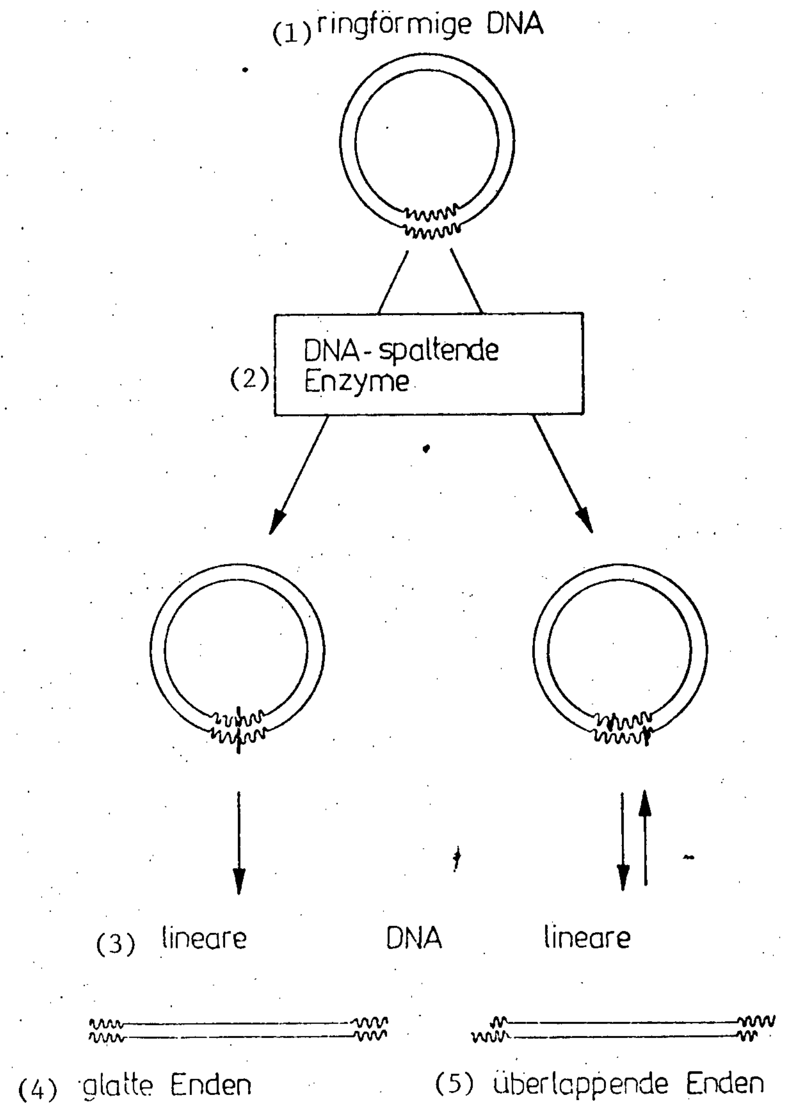
Determinierung der Proteinsynthese

Das zentrale Dogma der Molekularbiologie. Die dicken Pfeile geben den Fluß der genetischen Information an. Replikation = DNS-Synthese; Transkription = Synthese von RNS an DNS; Translation = Synthese von Protein an RNS; umgekehrte Transkription = Synthyse von DNS an RNS mittels eines spezifischen Syntheseenzyms von RNS-Tumorviren. Die dünnen Pfeile geben die notwendigen Wechselwirkungen von Eiweißen mit Nukleinsäure an, wodurch die Syntheseprozesse ablaufen und sich entsprechende Zellstrukturen bilden. Die umgekehrte Transkription ist eine Möglichkeit, spezifische DNS-Abschnitte zu synthetisieren

Legend for First Illustration

Determination of protein synthesis. The central dogma of molecular biology. The dark arrows show the glow of genetic information. Replication = DNA-synthesis; transcription = synthesis of RNA from DNA; translation = synthesis of protein from RNA; reverse transcription = synthesis of DNA from RNA by means of a specific synthesis enzyme from RNA-tumor viruses. The light arrows indicate the necessary interactions of albumins with nucleic acid through which the synthesis processes proceed and form corresponding cell structures. Reverse transcription is one possibility of synthesizing specific DNA-segments.

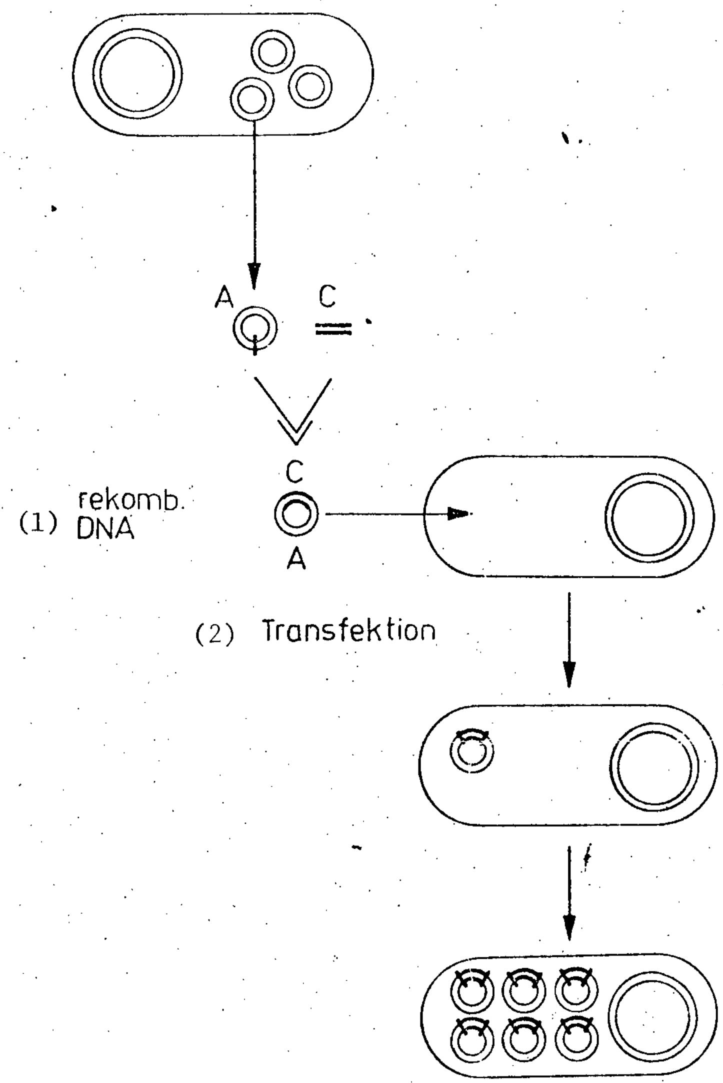
Key:
1. ring-shaped DNA
2. DNA-splitting enzymes
3. linear
4. smooth ends
5. overlapping ends



Legend for Second Illustration

Derivation of defined DNA-segments from DNA-splitting enzymes.

Key: 1. recombinant DNA
2. transfection



Legend for Third Illustration

Multiplication of recombinant DNA in the host. A = plasmid-DNA as vector; C = foreign double-stranded DNA-segment; AC = recombinant DNA produced in a test tube with which bacterium is infected. Multiplication occurs in this bacterium.

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MICROCOMPUTER EQUIPPED NETWORK FOR HUNGARIAN RAILWAYS

Budapest KOZLEKEDESI KOZLONY in Hungarian No 5, May 78 pp 208-217

[Article by Dr Peter Winkler, Istvan Foldy and Jeno Kojnok: "The Use of Microcomputers in the Field of Railway Traffic"]

[Text] Introduction

During the last few years, the technically advanced railway systems initiated the widespread application of electronic computers to solve transportation-control problems. The ultimate goal of these developments is to create a cooperative computer network which will make it possible to follow up on all levels (such as marshalling yards, large-traffic freight-loading stations, railroad management and the overall network) the status of all mobile units which take part in the transportation process (such as railway cars, locomotives, train and engineering personnel, etc.) and to satisfy completely automatically the information needs of management.

The complex automatic freight-transportation supervising system which includes the storage, transfer and further multilateral development of the information--and also satisfies the information needs of data-transfer and decision-making processes--is designated in the technical literature as the central supply control system.

Within the framework of central supply control system:

--the computerized system relieves the control organs from the routine data-collecting activity and simultaneously provides practically instantaneous automatic information, which in turn makes it possible to focus their activity on actual supervisory, decision-making and control-type work--in most cases also with the assistance of computers. The computer provides help in the decision-making process by analyzing the data and by using the techniques of operations research for optimizing the process design;

--it is possible to reduce considerably the manual record-keeping required for operation and control. At present, during one round trip of a vehicle, the data are collected 30 to 40 times in the manual information system (freight car registries, traction-load log, car-loading records, car-ordering list, various accounts and statistical summaries, etc.);

--the precision of the data and informational values has been considerably improved; this is due to the fact that the data are entered only once and with more care than customarily; afterwards the data are handled by a highly reliable machine-based system;

--the automated information control system represents an excellent basis for the complete automation of the individual partial processes of the transportation process because it provides information to the automatic units which control the marshalling yards and the railway traffic;

--the above-listed advantages increase the transportation capacity of the vehicle park, the transfer capacity of the marshalling yards and railway lines, ensuring a more efficient overall operation of the system.

In addition to the set of machine units at the network level which carry out complex operations as part of the central supply control system, computers (data concentrators) were installed at the railway directorates, at the marshalling yards with intermediate and large traffic and at the large freight loading stations. These machines are connected to the central computer park by means of medium-speed data-transfer devices.

The low-volume stations communicate with the central computer complex by means of terminal equipment, transferring the data to the concentrators at low speed (50 to 200 baud), and from there to the central computer at intermediate speed (1200 to 2400 baud). In its final form, the system includes also completely automated data input points which identify the numbers of freight cars, traction vehicles and trains and indicate to the central computer the time and direction of passage, the identification numbers of the vehicles and of the reading unit. (At present such installations operate only at the U.S. railroads and it is not expected that they will be installed in the near future in European railway systems.) A possible version of the network structure of the central supply control system is shown in Figure 1.

The system takes care functionally of the following tasks:

a) The central computer complex, operating at the network control level:

--records (models) in real time with the help of a suitable data-base handling system the actual data of the mobile elements which take part in the transportation process, including also examination of the spatial distribution of these elements;

--satisfies the accounting and control information needs at the network and management level. The railway directorates can request and obtain the information needed for control through the concentrators by means of the installed terminal data-handling units. The following types of information are included:

--records of the number of vehicles;
--determination of the composition of the operating vehicle park;
--reports of loading and unloading operations according to the prescribed uncoupling order;
--reports of the entering and departing freight cars according to the prescribed uncoupling order;
--reports on the utilization of the locomotives;
--report on the work of the traveling personnel;
--supply of data for retrieval;
--information to the central shipping-fee calculating and accounting system;
--information needs concerning foreign freight car accounting systems and of the Joint Railroad Car Pooling Organization (CEMA);
--evaluation of the work of the stations;
--evaluation of the railroad traffic;
--registry of the work-time kilometrage performance of freight cars, locomotives and personnel;
--preparation of various statistics, etc.;

--carries out certain specific tasks with the help of suitable algorithms, such as:

--automated assembly of freight car-compensating and control plans;
--automated planning of the train traffic at the network level;
--automated planning of the local activities of junction points not provided with an independent computer;
--assembly of the turn-around data of locomotives and personnel, etc.

b) The local computers working within the framework of the central supply control system have the following tasks:

--recall of the constant and relatively constant data of the mobile elements from the basic registry for the purpose of establishing a local record with the help of a suitable identifier, such as the number of freight cars;

--compilation of local records in real time on the basis of local processes; preparation of the track lists;

--satisfying the information needs of the local and of the central control system;

--automation of assigned local tasks (for example, local preparation of the operational work plans of processes);

--carrying out the automated management and control of processes as instructed.

c. Marshalling yards with a low-volume traffic and loading stations communicate with the central computer through a terminal and the automatically recalled data may be handled manually in the future to satisfy local information and process-control needs.

Development of the central supply control system requires considerable investment and therefore, in order to reduce these expenses, more and more railroads use in their own control system the latest technical development of computing technology the relatively low-cost microcomputers. These machines are used primarily as data concentrators and machines for handling local tasks. (The cost for establishing a marshalling-yard system with a microcomputer machine to only about one-fourth of the cost of a system based on a conventional computer.)

Within the Fifth Five-Year Plan the Hungarian State Railways (MAV) have also started to develop a central transportation control system and as the first stage the so-called computer-based border-traffic information system will be established to check the foreign and in-transit freight cars and to handle all aspects of the data related to this traffic. [1]

In addition, the development of the control and information systems of marshalling yards has been started.[2]

General Description of Microcomputers

A microprocessor is defined as a system consisting of one, or at most of a few, integrated circuits, which is able to assume the tasks of the central unit of a programmable computer.

A microcomputer is defined as a system which is provided with a microprocessor to handle the tasks of the central unit; it is provided with storage units (memory) for the information input and output; with peripheral control capacity, and can be used independently to be connected to peripherals of conventional computers (such as punched-tape or punched-card reader or puncher, background storage, display unit, printer, etc.).

The memory which is used primarily for storing the program is an important part of the computer.

The following semiconductor-type memories are used in microcomputers:

ROM	Read only memory. The input is final.
PROM	A storage system, into which the user may input only once.
REPROM	The already entered information may be removed by ultraviolet radiation and the system may be programed anew
RAM	Random access memory. Memory may be reached at will. May be inputted and read.

The widespread application of microcomputers, even elsewhere in the world, was started only a few years ago. The first microprocessor suitable to serve as a central unit was made available commercially in 1971. Since then the rate of production has increased dynamically and as a result of their small dimensions, wide range of application and the relatively low price, microprocessor-based computing tools are appearing in many new fields.

Use of the microcomputers has made the man-machine interaction more direct because they may be operated by means of previously entered programs.

The VTS 56 100 Type, Microprocessor-controlled Intelligent Terminal

The terminals currently in operation were acquired in 1975. The VIDEOTON plant developed these terminals for use as an intermediate-speed data transfer device; locally, they were intended to be used only for data preparation.

The wider application in local operation required an increase in the size of the memory and the development of the software system (translation program, etc.).

The schematic diagram of the terminal is illustrated in Figure 2, according to which it contains the following hardware units:

1 INTEL 8008-1 type central unit with microprocessor

Principal technical data:

Data handling:	parallel, binary
Word length:	8 bit
Memory:	REPROM 5.5 kbyte
Storage:	RAM 11 kbyte
	Access time: about 1 µsec
	7 8-bit scratch-pad registers (1 accumulator and 6, 8 14-bit stack registers (program counter)
	1 8-bit command register
Command length:	1-2-3 bytes
Command store:	48 commands
Cycling time:	12.5 µsec

--1 VT 340 type alphanumeric display;
--1 VT 343 type 80-column line printer with 365 to 1,110 lines/min capacity;
--1 CT-2200 type 1,000 to 2,000 card/sec capacity 5, 8 channel punched-card reader;
--1 DT-105/S type 110 card/sec capacity 5, 8 channel punched-tape puncher;
--1 Facit 4203 type 350 cards/sec transfer velocity, magnetic-casette storage unit;
--3 teletypewriter interface units;
--1 synchronous data-transfer unit
--1 synchronous/asynchronous 600/1200 bits/sec transfer speed MODEM.

Data transfer characteristics:

Data transfer mode:	synchronous, semi-duplex code-dependent or transparent transfer, 2- or 4-wire telephone connection
Data transfer speed:	600/1200 bits/sec
Data transfer algorithm:	BSC (Binary Synchronous Communication)
Block length:	64, 80, 128 or 256 characters
Error correction:	automatic block repetition

The terminal may be operated in on-line and off-line mode.

In the on-line mode an intermediate-speed data-transfer may be achieved through a telephone-line connection between terminal and terminal or terminal and computer.

At present, as part of the experimental border-station data collection system, the terminals at the Szeged Directorate of MAV and at the Computer Center of MAV in Budapest are connected with the R 10 computer.

The message traffic between the terminal and the computer is handled by means of operational algorithm and the linear data transfer process is executed with the help of a program entered in REPROM.

In the off-line mode the terminal operates as a microcomputer and is especially well suited to carry out data-collection tasks which require considerable access to the memory.

The efficient utilization of the computer depends on the availability of a suitable software for the system and users.

The software of the present system contains the following elements:

--systems monitor,
--editing program,
--assembler program and
  test programs,
--memory tests
    REPROM test,
    RAM test,
--display test,
--reading test,
--printing test,
--on-line test.

After completion of the development work of the systems software, part of which was carried out by the computer staff members of the Szeged Directorate, the users' programs related to the border-station were worked out.

It is planned to use these terminals widely within the framework of the border-traffic information system; they will there play the role of a data-handling terminal and will also participate in the processing of local information. Such terminals are being installed at the border stations of Zahony and Kelebia and at all railway directorates; they will be used to maintain contact between these points and the national border-traffic system. These terminals will receive from the national system all information generated by the national operations to be used by the directorates. Within the framework of the border-traffic system the terminals at the directorates will have other roles, beyond maintaining contact, and the computing specialists of the Szeged Directorates developed the following programs to facilitate the handling of these tasks:

1. Simplified operational-data collection, data distribution and data handling.

Should errors arise in the national border-traffic system, the system based on microcomputers will carry out data-handling activities following the principles illustrated in Figure 3, in order to satisfy the information needs of the border stations and of the Main Division of the Railways. This means that even if there were an error in the central system, it will not be necessary to fall back on manual operation and the existence of a reserve plant is ensured.

2. Preparation of the received and dispatched freight car data messages of INTERFRIGO for use by the border-traffic system.

3. Inspection, correction and preprocessing of the data messages of repaired foreign freight cars within the framework of the border traffic system.

4, Inspection, correction and preparation of the data messages of freight cars loaded for export.

By means of programs 2 to 4 the terminals participate to a significant extent also in the information-handling activities within the framework of the border-traffic system.

With the help of the programs mentioned under Point 1, the simplified system has been in continuous operation within the territory of the Szeged directorate since 1 October 1976, with a cycling time of 6 hours. This presented an opportunity to test the individual services in actual operation before completion of the national remote data collection system.

The MAV-51 System of Komarom

The computing technology department of the Budapest Directorate of MAV was assigned the task to develop a plan concerning the application of the

MO-51 type microcomputer developed by the Institute for the Coordination of Computing Technology for marshalling stations and to prepare the operation of such a system at Komarom. The tasks to be carried by the microcomputer belong basically to two subsystems: on one hand, to the operation of marshalling yards, and on the other, to the problems of the border-traffic system.

Practical Application of the MAV-51 System

The suitable organization of the data storage (freight car data) on a unit surface of a magnetic disk makes it possible to indicate the freight cars in the marshalling yard according to tracks. This ensures that the operational tasks (such as acceptance of trains, preparation of classification lists, etc.) will be carried out rapidly and efficiently and that the necessary statistics will be compiled without planning separate data storage and certification.

The basic activity of the arrival area of a marshalling station is the acceptance of trains, during which the freight car data and of the corresponding bills of lading are matched with the car data stored in the background memory of the microcomputer.

The freight cars may be entered into the systems by two means:

--by reading the tabulated punched tapes of the train analysis of the incoming trains; or

--by means of the data-terminal keyboard when its turn comes in the arrival area during the train acceptance operations.

At the end of the train acceptance, the microcomputer yields the verified data on the basis of the matched and corrected freight car data:

on the line printer	--	freight car registry
on the punched tape	--	arrangement list

The trains are switched according to the arrangement list; when that is completed, this fact is communicated to the microcomputer through the data terminal. As a consequence of this, the microcomputer transfers the freight car records in the freight car data base from the incoming tracks area to the corresponding outgoing tracks.

The cars in the departing trains must be matched before departure; this is achieved by using another data terminal. During the listing of the trains errors in the order and possible mistakes in the switching operations are corrected.

After the recording is completed a punched tape is obtained about the available classified date area yielding a list in five copies (train loading display).

After the departure of the train, the data may be used also for printing the traction load list.

The punched tape of the train loading record may be used after preparation of the necessary headpiece for initial analysis; it may be transmitted to the receiving station through the national teletyping network. In addition to the above-mentioned records, the system makes it possible to print from time to time the so-called Status Review concerning the position of trains and freight cars on the tracks of the marshalling station. This status review increases the efficiency of operational management.

In addition to operational activities, it is possible to classify the data according to specialty concerning the performance and statistical information at marshalling stations (incoming and dispatched trains, number of switched cars, etc.).

The machine-based preparation of needed documents and data carriers is ensured for the incoming and departing trains in border traffic, and thereby through this activity the MAV-51 system is functionally connected also to the border-traffic information system.

The processing is carried out by means of so-called "procedures" which may be called up by commands. They are divided in three troups:

a) operation which is triggered by the occurrence of some event;

b) time-dependent functions (preparation of statistics), and

c) interrogation.

Event-oriented Manipulations

First procedure:

Its goal is the check up and storage of the tabular analysis (TA) of trains sent to Komarom station from other stations. The errors are shown in an error list which is used after the arrival of the train at the time of its acceptance.

Second procedure:

Data transfer at the time of the arrival of the train; it is used for status review.

Third procedure:

At the time of the acceptance of the train the preliminary information is checked, and if needed, corrected and supplemented. If no TA is available, local data must be collected. After acceptance, the output is prepared, the freight car registry is printed and the punched tape of the classification list is prepared and may be transferred to the switching supervisor by means of a teletypewriter between points.

Fourth procedure:

After the classification is completed, the freight cars are rearranged in the machine also. Thus, there is information available at any given time to indicate the momentary situation (volume of cars, actual and recalculated number of axles and the tonnage of the load resolved according to track).

Fifth procedure:

When the train is accepted (this may occasionally be preceded by classification) the data are again matched, providing the train loading record. This data set is recorded on a punched tape.

Sixth procedure:

The data communication step related to the departure fulfills a statistical function; it sets free a departure track region and also triggers the printing of the traction-load record.

In the course of Procedures 2 to 6, memory regions are designated on the magnetic disk, in correspondence with the station's track network, and the data are stored there.

Seventh procedure:

This procedure compiles the incoming freight car registry; the punched-tape based output ensures that the desired number of copies will be produced. The data base is supplemented during the next phase. At that time become available all data needed for the preparation of the punched tape on the incoming freight cars registry's data message for the border-traffic system.

Eighth procedure:

Its purpose is to ensure the data for the departing freight car registry in the border traffic. Only the previously not included data are accepted in this process.

The required outputs, such as

--departing freight car registry,

--status of departing cars, and
--data messages of the departing cars may be prepared from this data base.

Statistical Functions

The system prepares daily and for each specialty the statistics needed to evaluate the work. This makes it possible to print the following lists:

--incoming trains,
--classification performance and
--departing trains.

Interrogation Potential

The control instrumentation of the station follows up the train data-collection process. The system can be interrogated concerning a status review for individual tracks, receiving, departing or directional track groups.

Hardware Structure

The system designated as MAV-51, developed on the basis of the MO-51 micro-computer, consists physically of the following elements:

--A central unit with twin processors, provided with an 8-k long RAM and a 4-k long ROM semiconductor memory (8 bits word length). The two processors check each other continuously by means of a test program.

1 DISCMOM-type fixed-dial magnetic disk unit with a capacity of 800 kbyte.
1 DZM 180 type line printer, with 132 characters per line.
1 ANKER printer with 76 characters for the listing of the processes which take place in the system.
1 ER 40 type punched tape reader for reading the tabulated analyses transmitted through the teletypewriter.
1 EP 35 type punched card puncher, to be used for preparing the intermediate data carrier for lists in several copies.
3 keyboard-display units to provide connection between the system and its users.

The hardware structure of the installation is illustrated in Figure 4.

The MAV-51 system contains the following systems components (Figure 5):

Physical computers:

It comprises the central unit of MO-51, the memory blocks, the UNIBUSZ and those portions of the disk which take part in the solution of a running problem. The physical machine, in particular the memory in actual use, may change from task to task.

Computer multiplexor:

This device enables the physical machine to solve several tasks in parallel. Naturally, the machine executes physically only one instruction at one time; that instruction can involve only one task. The computer multiplexor contains those parts of the central unit, the memory block, etc., which initiate, control and stop the run; that is, they arrange the rate of the various steps of the tasks in such a way that the users gain the impression of simultaneous operation.

Virtual computers:

A keyboard display unit belongs to each of the virtual computers assigned to an individual task. Each of the virtual computers represents a copy of the physical computer to solve a specific task. All virtual machines may be transformed into a physical computer; this is achieved by means of the computer multiplexor whenever certain conditions are fulfilled. One of the virtual computers becomes activated while the others are stored in a specific portion of the magnetic disk. This arrangement makes it possible to take advantage of all services of the computer for each task.

Resource Multiplexor:

The following sources are available:

--two kinds of line printers,
--punched band reader,
--punched band puncher, and
--disk files.

The resources, or rather their application, cannot always be distributed between the programs. For example, if a long list is being prepared on the line printer, it would not be suitable to intercalate one or two lines belonging to another program.

Every program may request a resource and the resource multiplexor tries to satisfy the requests. If possible, the requested resource is assigned to the virtual computer on which the requested program is run. This assignment prevents the resource from being used for another purpose. Whenever the program does not need the assigned power resource, the latter is released.

Schematic Description of the Operation of the MAV-51 System

The system keeps in touch with its potential users through the keyboard-display units. In order to start the operation, a command which initiates a procedure ensuring a service must be given on one of the free keyboards. In response to the final character of the vehicle-return command the system deciphers the command. If the command is unknown or incorrectly stated, the system sends an error signal to the calling operator; in case of a correct command, it selects the work program, able to satisfy the request expressed in the command. This new program is executed on the same virtual computer, on which the command was deciphered. If necessary, its keyboard-display makes it possible to enter additional information (such as freight car records). The program selects the power resource that it needs.

While the above-mentioned events take place, another operator may request any other kind of service on one of the free displays. At that moment the system would like to solve simultaneously both programs but as this is impossible, the actual order must be decided upon. Reaction to a command requesting a service is the most important; in that case, data input activity of the other program may be somewhat delayed. The waiting period amounts only to a few tenths of a second. Analysis of the command requires a physical computer; however, that is occupied by the previously initiated program. Therefore, the earlier program is shifted to the actual machine assigned to the keyboard unit, together with all parameters which may be needed for a subsequent run. Afterwards the next actual machine is entered into the just freed physical machine to execute the command-control procedure. The main goal of the machine at this time is to ensure that the two procedures are running in such a way that they will not noticeably interfere with each other.

For example, if the train-acceptance procedure--the second to be started--has reached the point that it requested the first freight-car record, the writing of which would require about one half minute, and during that time the procedure is unable to do anything useful, it must be determined whether the procedure which started first could be doing something. If the answer is yes, then the virtual machine of the first procedure is brought back into the physical system and will be operated while the second one is excused. This process is continued until all procedures are completed.

The systems-technical structure of the MAV-51 system may be described in the following manner:

--it is a multiprocessor, multiprogram hardware-and-software system, the elements of which are determined in the first place by the systems functions dimensioned for the optimal satisfaction of the demand; in the second place by the need to protect the system's own integrity against operator or physical errors; and in the third place by maximizing its reliability;

--satisfaction of the demand makes it necessary to use a multiprocessor system, assigning one of the processors to collect and handle the input data, and the other to actual data processing;

--the volume of the data to be handled and the manual nature (slowness) of the input operation makes it necessary to use a simultaneous, multiprogramed processing technique;

--the data structure is organized in such a way that it is possible to ascertain what point the file development has reached; this is important in the case of restarting after an eventual faulty operation;

--the system can be expanded without any difficulty on the one hand in the direction of repeated multiprogramed applications, and on the other hand, in the direction of multiprocessor structures.

The Software of the MAV-51 System

The software of the MAV-51 system is based on the principle of multiple programing; it has the following main elements (Figure 6):

--Scheduler is the "soul" of the system; it designates the task and its assigned program which will be executed next. The subject of the study is represented first by the COMMAND ANALYSIS procedure; the other procedures will be examined in turn.

--The COMMAND ANALYSIS (CA) procedure analyzes the commands, by means of which the various functions of MAV-51 may be called. Examples of such commands are ANALYSIS, CLASSIFICATION, ACCEPTANCE, etc. CA only designates the procedure to be executed but the actual execution is within the purview of SCHEDULER.

--PROCEDURE K-D-1-K-D-3 (transient procedures) consist of three tasks which have been designated by CA for running during an earlier operational phase and assigned to a specific K-D (keyboard-display) terminal unit. Of these, only one can be in the operational store. The procedure exchange is designated as SWAP. The procedure is lifted from the memory into the SWAP-STACK field of the magnetic disk while the procedure intended for the run is entered into the operational store. SWAP-STACK is able to store three procedures simultaneously.

--The PROC I ...PROC XX are command-executing procedures, from which the CA develops one of the K-D procedures by designating and assigning the peripherals.

--MONITOR UTILITIES are peripherals-handling and resource-allocating modules. Handling of the peripherals ensures the unified utilization of the peripherals and also represents a considerable common portion of the procedures. The purpose of the resource allocation is to resolve conflicts that may arise between procedures which want to use the same peripheral.

Control of the peripherals results in program interruptions (IT); this is how each peripheral indicates that its task has been accomplished.

The IT HANDLER takes care of the program-interruption demands of the peripherals.

The following results are expected from the application of the system:

--improvement of the quantity and quality of the information supply;

--improved scanability and legibility of the displays prepared by the computer;

--reduction of the administrative workload of the staff;

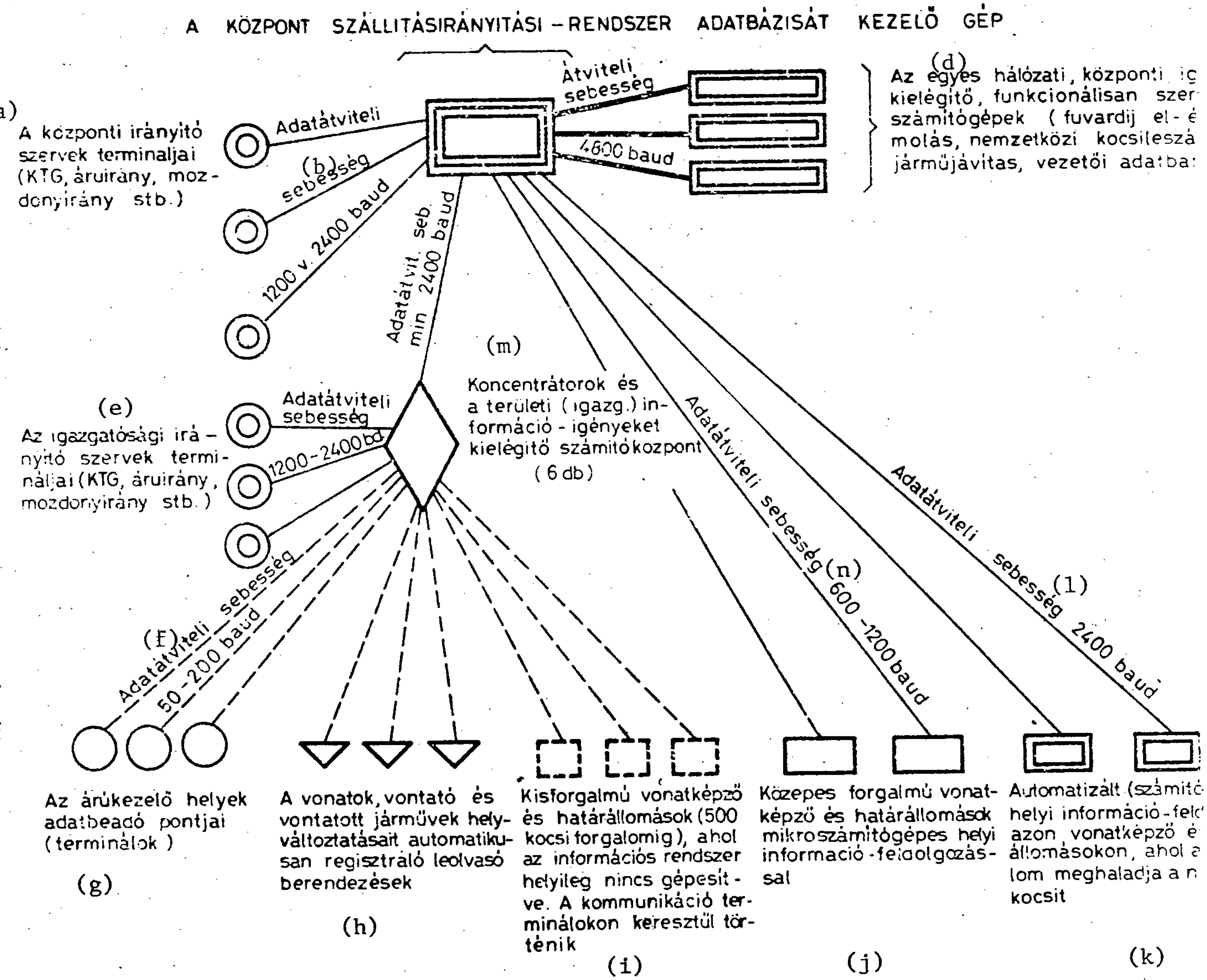
--increased technological discipline;

--improvement in the working conditions;

--increased operational efficiency.

The experimental operation of the MAV-51 system has been realized during the second half of May 1977. Results of the experimental run up to now have been promising and therefore the management of MAV plans to place additional microcomputers in operation. In order to enable these computers to fulfill the functions of the local machine of the central supply control system, a remote data transmitter adapter is being developed; it will ensure in an on-line mode the communication between the computer park of the MAV Computing Center and the local microcomputers.

Figure 1. The machine which handles the data base of the central supply control system



(p)

1. ábra. A központi szállításirányítási rendszer számítógép-hálózata

[Key on following page]

Key to Figure 1.

a. Terminals of the central control organs (KTG, direction of the goods, direction of the locomotive, etc.).

b. Data transfer rate 1200 or 2400 baud

c. Transfer rate 4800 baud

d. Functionally organized computers which satisfy certain network or central requirements (accounting for freight charges, international accounting for freight cars, vehicle repair work, management data band, etc.

e. Terminals of the directorate's control organs (KTG, direction of the goods, direction of the locomotives, etc.)

f. Data transfer rate 50 to 200 baud

g. Data input points (terminals) of the merchandise-handling areas

h. Devices which record automatically the changes of place of trains of traction units and trailing vehicles

i. Switching and border stations with small traffic (up to a freight car circulation of 500 units) where the local information system is not computerized. The communication is realized through terminals

j. Switching and border stations with intermediate-volume traffic which handle the local information load by means of microcomputers

k. Automated (computerized) handling of the local information in those switching and border stations, in which the traffic exceeds 200 freight cars per day

1,0 Data transfer rate 2400 baud

m. Data transfer rate 600 to 1200 baud

n. Concentrators and computer center satisfying regional information needs (of the directorates)

p. Figure 1. The computer network of the central supply control system.

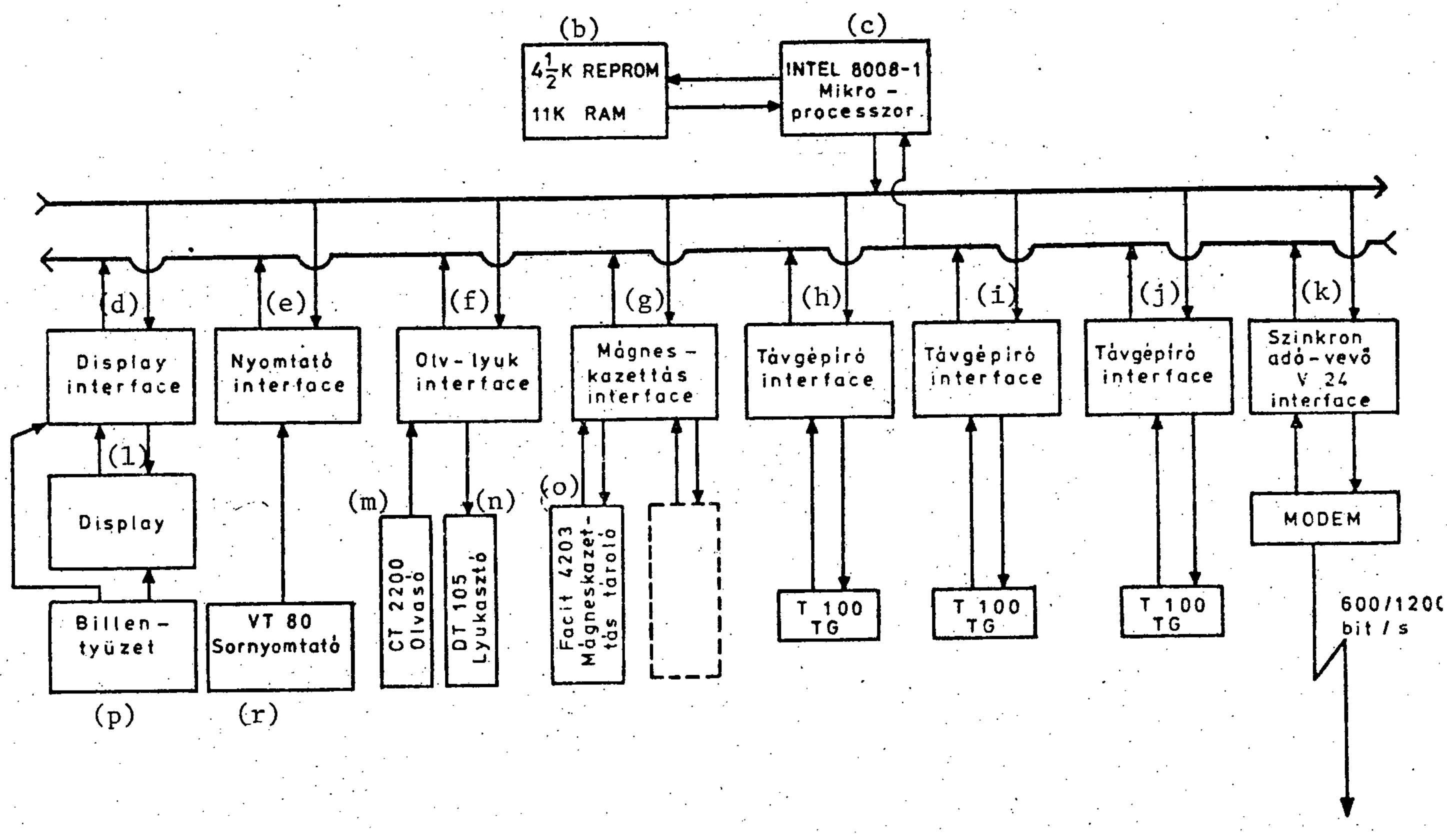
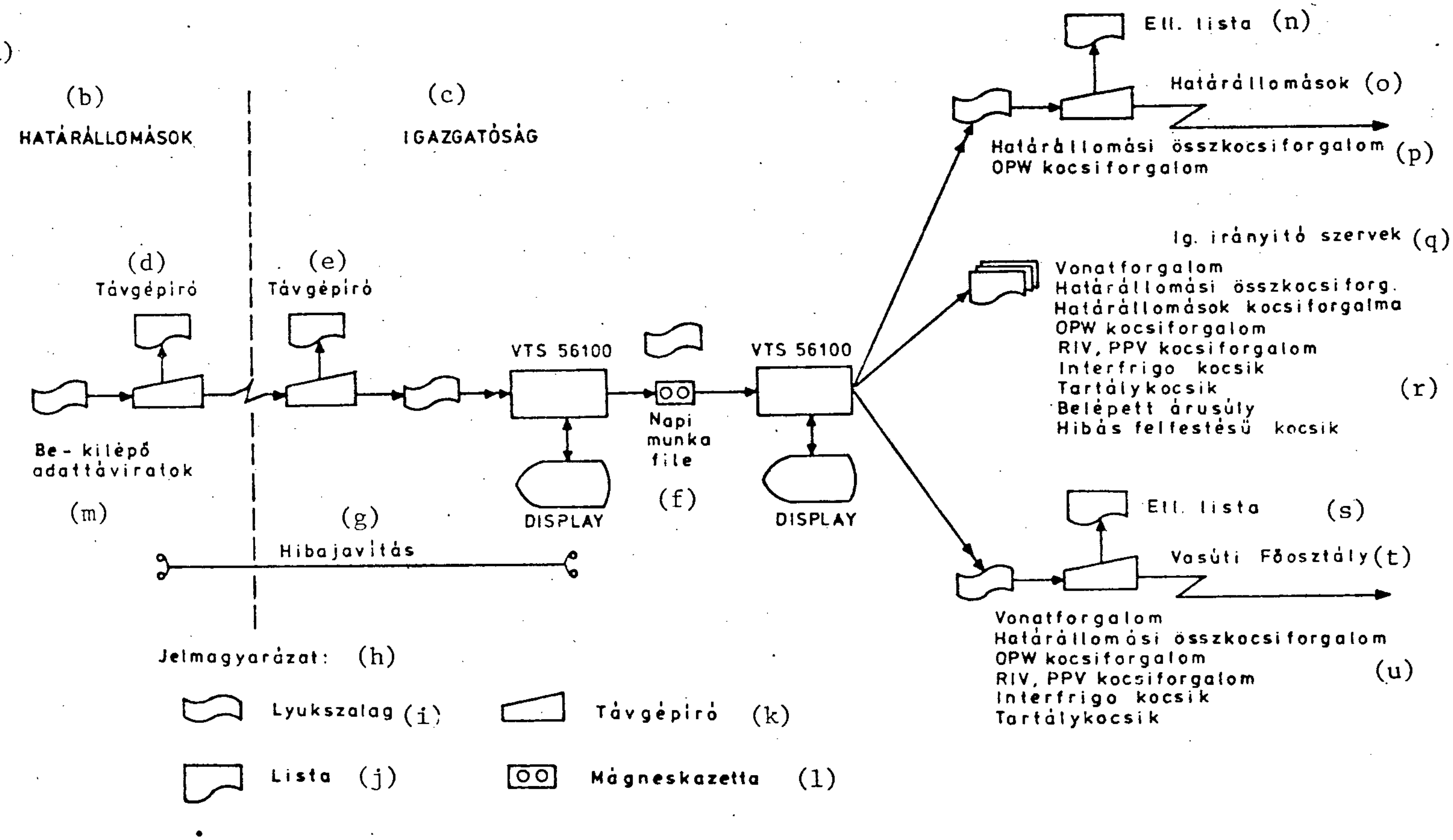


Figure 2. Schematic diagram of the intelligent terminal VTS 56 100

Key:

- b. 4 1/2 REPROM; 11 K RAM
- c. Microprocessor INTEL 8008-1
- d. Display interface
- e. Printer interface
- f. Reader-puncher interface
- g. Magnetic cassette interface
- h. Teletypewriter interface
- i. Teletypewriter interface
- j. Teletypewriter interface
- k. Synchronous sender-receiver V-24 interface
- l. Display
- m. CT 2200 reader
- n. DT 105 puncher
- o. Facit 4203 magnetic cassette memory
- p. Keyboard
- r. VT 80 line printer

best as in original



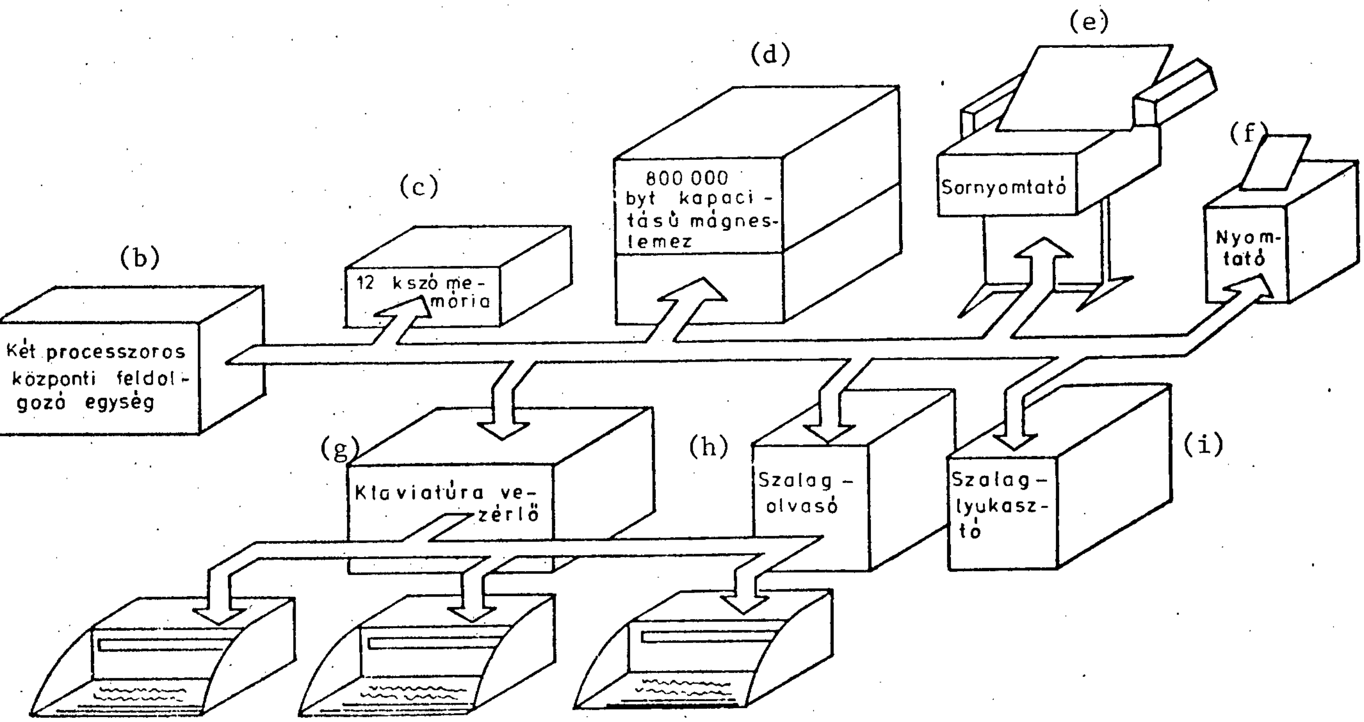
3. ábra. Mikroszámítógépes egyszerűsített operatív rendszer működése

Figure 3.

[Key on following page]

[Key to Figure 3]

a. Figure 3. Operation of the computerized simplified working system
b. Border stations
c. Directorate
d. Teletypewriter
e. Teletypewriter
f. Daily work file
g. Error correction
h. Legend
i. Punched tape
j. List
k. Teletypewriter
l. Magnetic tape cassette
m. Input and output messages
n. Check list
o. Border stations
p. Total freight car traffic at the border station. Freight car traffic from the Joint Rail Car Pooling (CEMA) system
q. Management control organs
r. Train traffic
   Total freight car traffic at the border station
   Freight car traffic of the border station
   Freight car traffic from the Joint Car Pooling (CEMA) system
   RIV, PPV freight car traffic
   Interfrigs (refrigerated) cars
   Cistern (tank) cars
   Weight of entering merchandise
   Erroneously printed cars
s. Check list
t. Main Railway Division
u. Train traffic
   Total freight car traffic at the border station
   Freight car traffic from the Joint Rail Car Pooling (CEMA) system
   RIV, PPV freight car traffic
   Interfrigs (refrigerated) cars
   Cistern (tank) cars

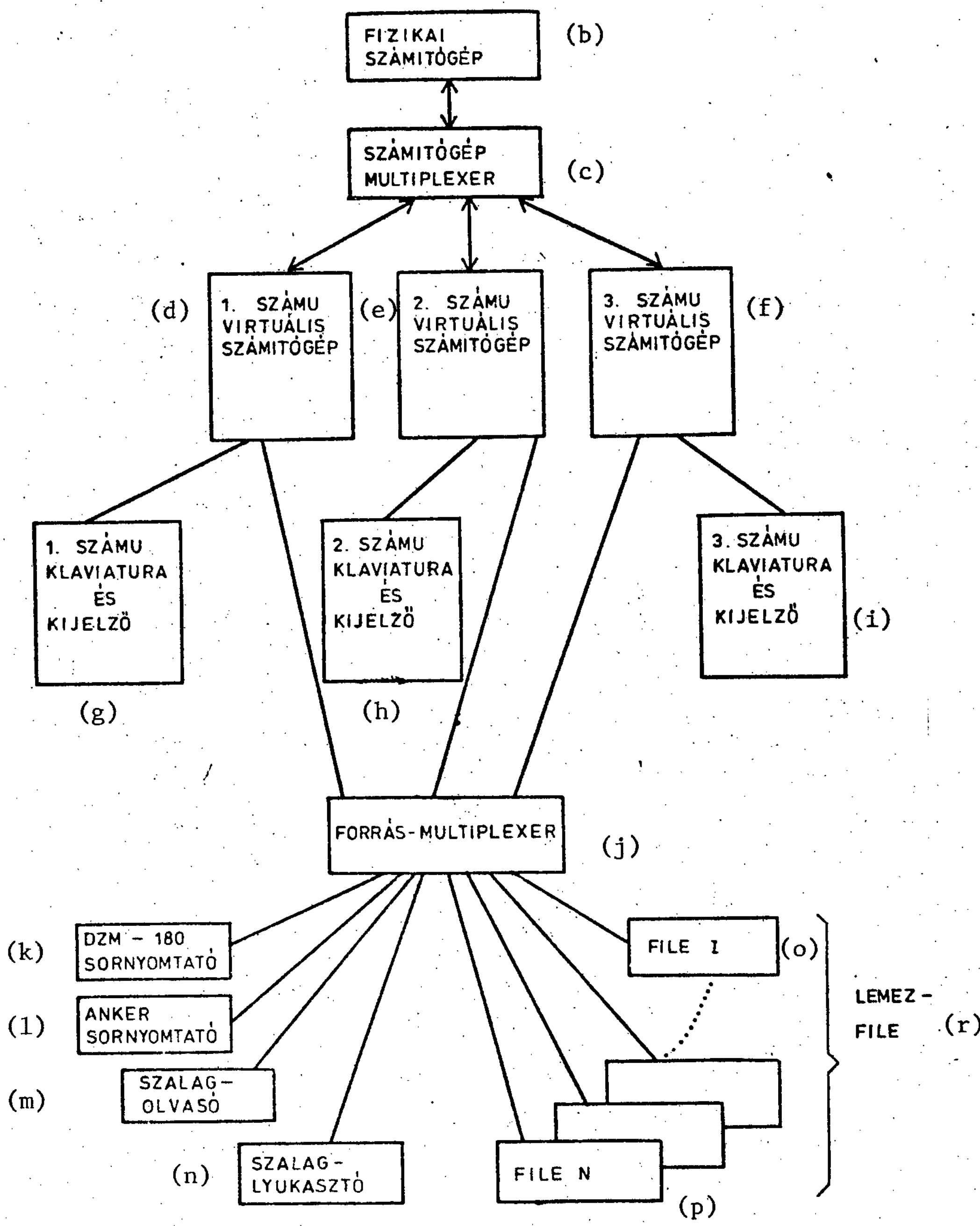


(a) 4. ábra. Az MO—51 mikroszámítógép harware felépítése.

Figure 4.

Key:

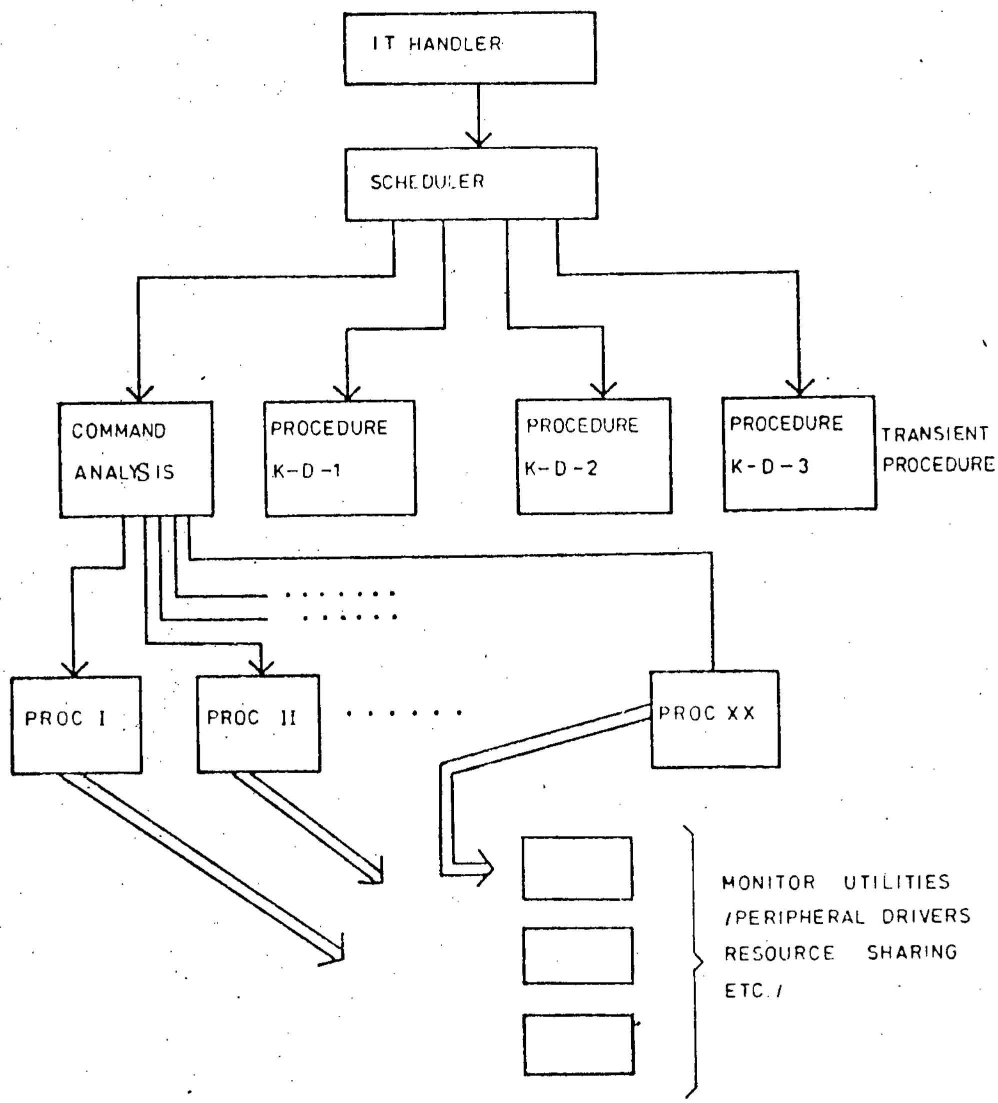
a. Figure 4. Structure of the hardware of the MO-51 microcomputer
b. Central data handling unit with two processors
c. 12 k word memory
d. 800,000-byt capacity magnetic disk
e. Line printer
f. Printer
g. Keyboard control
h. Tape reader
i. Tape puncher



(a) 5. ábra. Az MO—51 rendszer komponensei

Figure 5.

Key:
- a. Figure 5. The components of the MO-51 system
- b. Physical computer
- c. Computer multiplexer
- d. Virtual computer No 1
- e. Virtual computer No 2
- f. Virtual computer No 3
- g. Keyboard and indicator No 1
- h. Keyboard and indicator No 2
- i. Keyboard and indicator No 3
- j. Resource multiplexer
- k. DZM-180 type line printer
- l. Anker type line printer
- m. Tape reader
- n. Tape puncher
- o. File I
- p. File N
- r. Disk file



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LOW FREQUENCY RADIO WAVES USED TO DETECT BAUXITE

Budapest MUSZAKI ELET in Hungarian 14 Jul 78 p 5

[Unattributed article from the Association of Hungarian Geophysicists]

[Text] It is a typical feature of bauxite prospecting that a bauxite deposit having a thickness of 10 meters and an expanse of even a few hundred meters is a valuable economic asset.

Until now, deposits of this size could be located only with much effort and expense by carrying out trial drillings. The need therefore developed for more modern geophysical techniques capable of indicating the presence of such deposits. Under the sponsorship of the Central Bureau of Geology a new method was developed. We asked Dr Laszlo Szabadvary, senior scientific department head at the Hungarian State Eotvos Lorand Institute of Geophysics, member of the Association of Hungarian Geophysicists, about this method.

The New Instrument

"Radio transmitters operating at the low frequency of 20 kHz have been used by navies for a long time to control submarines capable of operating at great depth. There is a network of such stations encompassing practically the entire globe. Only the low-frequency radio waves are capable of penetrating deep waters. They are also capable of penetrating into the solid matter of the continents. The depth of penetration depends on the type of rock; it may be as much as practically 100 meters or as little as a few tens of meters."

"A Canadian firm was the first to recognize the potential of this constant and ubiquitous energy source for prospecting by geophysical means deposits of non-ferrous metal ores. It developed a small-size measuring instrument resembling a small movie camera with which the field measurements can be made in a fully automatic manner within no more than 1-2 minutes. The instrument is so highly sensitive that it can sense the magnetic and electrical components, as well as any phase shifts in them, at an accuracy of one to two percent even if the transmitter is located as much as several kilometers away. Thus, the radiations may be regarded as being planar waves coming from an infinite distance and creating a secondary field in the ground at the site of the measurement. The instrument determines and digitally displays the apparent impedance of the rocks from a comparison of the received primary and secondary fields. The displays permit geophysicists to draw useful conclusions about the character of the rocks since the electromagnetic waves are absorbed many times as fast in ore-bearing rocks than in the mother rock. The difference depends on the character of the ores present."

"On the basis of the above, Kristof Kakas, scientific department head in our institute, assumed that the method may be useful for prospecting for bauxite in Hungary provided that we improve the sensing technology and refine the methods of mathematical processing. If these conditions are met, we could measure the relatively small effect of near-surface bauxite deposits. The conditions were met by the year of 1974. Thereafter, we developed a bauxite-prospecting concept which uses the relatively cheap low-frequency radio wave (VLF) technique to generate geophysical data on 90-95 percent of all areas, telling us where there is no bauxite. This would save us several million forints per square kilometer since we no longer need to carry out trial drillings."

"Accordingly, we may concentrate on the remainder of the territory, perhaps 5-10 percent of the entire area, where we may carry out prospecting by other means such as potential mapping, gradient-mapping of the drilling surface, spatial seismic refraction measurements, and so forth. These are expensive techniques, but we can restrict their use to promising regions. It was demonstrated that a unified geological interpretation of the results obtained in this manner would give us information about the character of the potential bauxite-bearing structures in a direct manner, so that trial drillings could be considered in places where the probability of success is relatively high.

Trials in Transdanubia

"We carried out trials with the new technique in the Central Mountains of Transdanubia, specifically in Iharkut, in cooperation with the Bauxite Prospecting Enterprise of the Hungarian Aluminum-Industry Trust.

This area has the advantage that the VLF transmissions for naval purposes from Moscow, Bordeaux, Bari, and the London area can be very well received there so that radiation sources from four directions are available for the measurements. The observations indicate that 90 percent of the approximately 50 square kilometer area charted in the 50-meter geodetic network is devoid of ore deposits. We confirmed the reliability of this conclusion by carrying out trial drillings in the areas judged to be devoid of deposits. In each we found Triassic temporary dolomite or Dachstein limestone which are known to have no bauxite-bearing structures. At the same time, we continued geophysical studies on the remaining 10 percent of the area. After the conclusion of these studies, we carried out many trial drillings in 1966-1967. We detected a significant amount of bauxite."

Dr Laszlo Szabadvary explained that the primary advantage of the VLF method for the Hungarian economy is the fact that it provides information about the character of the layers relatively close to the surface, which is just what we require. In this depth area the method is quite suitable. It should be realized that mining of the close-to-surface deposits can be made from the surface, so that we do not have to deal with the usual difficulties accompanying the mining of bauxite from greater depths, such as carst-water breakins, and that we can operate more economically. He also informed us that the authorities will explore close-to-surface sites preferentially in the future since if we have more of them they can be exploited in an economically very favorable manner.

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